APPENDIX G
VEGETATION AND WETLANDS ANALYSIS

G.1 INTRODUCTION

This section describes the historical, existing and desired future conditions of the riparian, wetland, and associated upland plant communities of the Milltown Reservoir Sediments Operable Unit. Many factors influence existing vegetation patterns including geomorphic setting, water source, hydrodynamics, soils, vegetation, land use practices, and disturbance, for example. In addition, land use patterns and human-caused disturbance have affected significant shifts in vegetation communities, composition, and distribution.

G.2 HISTORICAL VEGETATION CONDITIONS

Because little information is available about vegetation prior to the construction of Milltown Dam, historical conditions are discussed based on observing riparian plant communities in adjacent reaches, combined with our knowledge of general disturbances affecting vegetation. Direct and indirect disturbances have altered ecological processes in the floodplains of both the Blackfoot River (BFR) and the Clark Fork River (CFR). Structures and activities that have altered ecological processes include: building of Milltown and Stimson dams, building of other infrastructure such as bridges, roads, and railroads, riparian grazing, development, and spread of invasive weeds. These activities have significantly altered the channel morphology as described in Section 2.4 which can affect the vegetation communities supported along the rivers.

In the absence of direct or indirect human disturbance, the historical channel and floodplain would have been narrower in Reaches CFR1, 2 and 3, and BFR1 and 2 than they are currently do to the reservoir operation and other land uses. These lower reaches of the Clark Fork and Blackfoot rivers likely supported forested riparian plant communities similar to those found in reaches CFR3 and the CFR upstream study reach prior to the existing landscape modifications. Vegetation communities likely consisted of non-climax cottonwood/red osier dogwood (*Populus trichocarpa/Cornus stolonifera*) communities interspersed with conifer dominated climax communities such as the Ponderosa pine/red osier dogwood (*Pinus ponderosa/Cornus stolonifera*) or Douglas fir/red osier dogwood (*Pseudotsuga menziesii/Cornus stolonifera*) habitat types (Hansen et al., 1995). Other historical plant communities likely consisted of willow (*Salix* spp.) and young black cottonwood community types on recently deposited sediments along the channel margins. Alder (*Alnus incana*) may have been dominant in isolated patches where cottonwood overstories died out and did not regenerate.

Historical upland communities that once characterized drier terrace vegetation have been significantly altered due to development. It is likely these areas once consisted of pine forest and grassland community types.

G.2.1 Existing Vegetation Conditions

Existing vegetation patterns are influenced by hydrology, soils, and natural river disturbance processes as well as land use patterns and human-caused disturbances. As described above, disturbances have caused significant shifts in plant community composition. Existing vegetation is classified and described according to Classification and Management of Montana's Riparian and Wetland Sites (Hansen et al. 1995). Plant communities are discussed in terms of their relationship to plant community succession and their response to natural and human-induced disturbance processes. The predominant plant communities occurring are described below by reach.

One of the most striking observations made while evaluating existing conditions on the floodplain was the significant weed infestations along streambanks and on floodplains. In the vicinity of Turah Bridge, reed canarygrass (*Phalaris arundinacea*) dominates the herbaceous layer under a stand of sandbar willow (Figure G-1). Common tansy (*Tanacetum vulgare*) dominates a point bar, spotted knapweed (*Centaurea maculosa*) occupies slightly higher microsites, and reed canarygrass has colonized the immediate streambank (Figure G-1). Because weeds are so significant, our revegetation strategies include several methods to limit weed infestation in restoration areas.



Figure G-1. Existing vegetation conditions on the Clark Fork River floodplain in the vicinity of the Turah Bridge. Reed canarygrass dominates stream banks (left). Other invasive weed species including common tansy and spotted knapweed are other frequent noxious weeds (right).

In addition to the most abundant weeds and invasive species described above, other invasive noxious and non-native weed species are well established within and adjacent to the restoration project area (Table G-1).

Table G-1. Well-established and observed or reported noxious non-native weeds found on the Clark Fork River floodplain in the restoration project area.

Well-established Noxious Non-native Weeds	Observed or Reported Noxious Non-native Weeds
Cheatgrass (*Bromus tectorum*)	Quackgrass (*Agropyron repens*)
Canada thistle (*Cirsium arvense*)	Absinth (*Artemisia absinthium*)
Houndstongue (*Cynoglossum officinale*)	Smooth brome (*Bromus inermis*)
Leafy spurge (*Euphorbia esula*)	Common mullein (*Verbascum thapsus*)
St. Johnswort (*Hypericum perforatum*)	Common Tansy (*Tanacetum vulgare*)
Dalmatian toadflax (*Linaria dalmatica*)	
Sulfur cinquefoil (*Potentilla recta*)	

Reach CFR1 and Powerhouse

Reach CFR1 (downstream of Milltown Dam) has a very narrow fringe of vegetation along the channel. The plant community is predominantly willows and other riparian shrubs mixed with wetland herbaceous species. A mid-channel bar is dominated by sandbar willow.

Reach CFR2

Reach CFR2 consists of numerous vegetation community types. Pine forest is present in this reach along the south bank in upland areas. Addition field review is required to evaluate CFR2.

Reach CFR3

Reach CFR3 consists of vegetation community types in various stages of succession. To the south of the river the vegetation is predominantly older age class cottonwoods with scattered pines along the channel. Wet areas in the floodplain are dominated by shrubs, predominantly black hawthorne (*Crataegus douglasii*) in more disturbed areas, and willow species in less disturbed areas. The north side of the channel is predominantly a cottonwood forest with an understory dominated by red osier dogwood, or in more disturbed areas hawthorne, alder or herbaceous vegetation. A heavy infestation of common tansy occurs in this reach.

The Riparian Wetland Research Program of the University of Montana (RWRP) collected data near the upstream end of this reach in 1996. This data indicate the reach is predominantly a Ponderosa pine/red osier dogwood community type. More heavily disturbed areas within the reach consist of mountain alder, reed canarygrass, and black cottonwood/herbaceous community types. Wetter areas within the floodplain are predominantly a common cattail (*Typha latifolia*) habitat type. Depositional areas along the channel margins are predominantly a sandbar willow (*Salix exigua*) community type.

CFR Upstream Study Area

The RWRP collected data near the downstream and upstream ends of this reach in 1996. These data indicate numerous habitat and community types within the reach. Forested types consist of quaking aspen/red osier dogwood (*Populus tremuloides/Cornus stolonifera*) habitat type, black cottonwood/red osier dogwood community type, black cottonwood/herbeaceous community type, and ponderosa pine/red osier dogwood. Shrub types consist of thin-leafed alder, water birch (*Betula occidentalis*), red osier dogwood, hawthorne, and sandbar willow community types. Herbaceous types consist of red top (*Agrostis stolonifera*), smooth brome, reed canarygrass community types, and common cattail and common spikesedge (*Eleocharis*

palustris) habitat types. Depositional areas along the channel were predominantly black cottonwood/recent alluvial bar community type.

Reach BFR1
The Blackfoot River within Reach BFR1 supports a narrow fringe of vegetation along the channel. This vegetation is predominantly a sandbar willow habitat type. Backwater wetland areas also exist in this reach and are dominated by reed canary grass.

G.2.2 Desired Future Condition

The desired future conditions are to restore the area to a condition similar to pre-dam construction, with all riparian, upland and wetland components functioning in concert. Baseline conditions in the restoration and reclamation areas were likely similar to those found along reaches upstream of the restoration project area in the absence of direct or indirect human disturbance.

The restoration area was likely predominantly forested cover types such as black cottonwood/red osier dogwood and ponderosa pine/red osier dogwood. The black cottonwood community type (Hansen et al., 1995) is a reference plant community that represents the desired future condition for significant portions of the floodplain along the CFR. The distributions of land cover types and balanced channel dimension, pattern, and profile are also used to determine the desired future condition. Nearer the confluence of the BFR and CFR plant communities may have also included shrub dominated cover types consisting of willow and other species.

G.3 WETLANDS AND OFF-CHANNEL HABITATS

G.3.1 Introduction

This section describes historical, existing, and desired future condition of wetlands and off-channel springs within the restoration and remediation area. Many factors influence existing wetland patterns—geomorphic setting, water source, hydrodynamics, soils, vegetation, land use practices, and disturbance, for example. In addition, land use patterns and human-caused disturbance have caused significant shifts in wetland abundance, composition, and distribution.

G.3.2 Historical Wetlands and Off-channel Habitats

Specific data are not available about the historical extent of wetland and off-channel habitats along the restoration project area before Milltown Dam was constructed. Construction of the dam significantly altered the hydrology behind the dam, resulting in extensive ponding. Dam effects extend approximately 13,000 ft upstream from the dam. Prior to construction of the dam the wetland area was probably not as extensive as it is currently.

G.3.3 Existing Wetlands and Off-channel Habitats by Reach

Existing wetlands are described using the Cowardin System, Identification of Wetlands and Deepwater Habitats, used by the U.S. Fish & Wildlife Service (USFWS) (Cowardin et al., 1979).

The information in this section is based on field observations and Upper Clark Fork River Wetland Mitigation Process Step 3 – Detailed Analysis by Walsh Environmental Scientists and Engineers, LLC. (2004).

Reach CFR1 and Powerhouse

Very little wetland habitat exists in this reach. The channel is in a very narrow canyon with limited floodplain access. Plant communities are described in the existing vegetation section.

Reach CFR2

This reach is located within the reservoir pool assessment area as defined in the 2004 FEWA Report prepared for the Milltown Sediment OU (EPA, 2004). This area consists of the reservoir pool and river channel and side channels upstream of the pool to Duck Bridge. Wetlands within this reach are primarily classified as Lacustrine (Cowardin, 1979) as a result of the expansive pool formed by the presence of the Milltown Dam. Other wetlands are palustrine and consist predominantly of wet meadow communities vegetated with dense stands of cattails, sedges, reed canary grass, redtop, rushes and bulrush. Meadows situated in proximity to standing water, ponds, or flowing water tended to have hardier and more diverse vegetative composition, while wetlands in areas with ephemeral sources of hydrology tended to exhibit vegetative communities that were more monotypic and were not always readily identifiable as wetland habitat. The meadows are fringed and/or interspersed with meandering groves of shrubs and trees including several willow species, black cottonwoods, river birch and thin-leaf alders in the lower elevations; and western snowberry (*Symphoricarpos occidentalis*), Woods' rose (*Rosa woodsii*), serviceberry (*Amelanchier alnifolia*) and gooseberry (*Ribes* spp.) along the fringes of upland habitat.

Palustrine wetlands, which occur along the fringe of the reservoir and channels and on the vegetated peninsulas and in backwater eddies are predominantly emergent wetlands (45 percent) and dominated by common cattail, sedge species (*Carex* spp.), and redtop. Other palustrine wetlands consist of scrub-shrub (35 percent) dominated by willow species, Wood's rose, prickly rose (*Rosa acicularis*), and western snowberry, forested (10 percent) dominated by black cottonwood, water birch and mountain alder and aquatic bed (10 percent) dominated by fennel-leafed pondweed (*Potamogeton pectinatus*), buttercup (*Ranunculus* spp.), and water lentil (*Lemna minor*).

Reaches CFR3 and the CFR Upstream Study Area

Reaches CFR3 and the lower end of CFR upstream study area are located within the braided river assessment area as defined in the 2004 FEWA Report prepared for the Milltown Sediment OU (EPA, 2004). The area consists of a palustrine system consisting of a mosaic of emergent, scrub-shrub and aquatic bed classes which dominate the braided sections in the river channel and almost all of the adjoining floodplain. There are dispersed pockets of open water ranging in size from 2 ft to 3 ft diameter pools, to expansive ponds in excess of an acre. The wet meadows are fringed and/or interspersed with meandering groves of shrubs and trees including several willow species, black cottonwoods, river birch and thin-leaf alders in the lower elevations, and snowberry, Woods' rose, serviceberry and gooseberry along the fringes of upland habitat. To the west is a series of expansive, meandering wet meadows predominantly occurring on the south bank floodplain and the vegetated islands situated between the braids of the channel. Ephemeral

sources of hydrology in the area tended to result in vegetative communities that were more monotypic and were not always readily identifiable as wetland habitat.

Emergent wetlands (45 percent) are dominated by common cattail, sedge species, and redtop. Other wetlands consist of scrub-shrub (35 percent) dominated by willow species, Woods' rose, prickly rose and western snowberry, forested (10 percent) dominated by black cottonwood, water birch and mountain alder and aquatic bed (10 percent) dominated by fennel-leafed pondweed, buttercup, and water lentil.

Reach BFR1

Very little wetland habitat exists in this reach. Vegetation is confined to a relatively narrow corridor that parallels the channels due to developments (e.g. roadways, commercial centers and residential homes), or the physical characteristics of the landscape (e.g. steep side slopes, upland terrain). Some backwater areas and channel margins are dominated by sandbar willow and reed canarygrass.

G.3.5 Desired Future Conditions

The existing wetlands within the restoration area were likely expanded by the hydrologic influence created by Milltown Dam. However, side slope hydrology is also feeding wetlands along the south side of the project. The channel types proposed through the restoration areas (single channel compared with braided channel) do not typically support the type of extensive back-water wetlands and wet meadows currently present. Channel types proposed for restoration typically flood and create depositional areas which provide substrates where willows and cottonwoods communities become established. Outside of this area, channels typically support forested or shrub dominated riparian areas. Infrequently, large floods may cause the channel to avulse, moving to an entirely new location and leaving behind an abandoned channel that develops into a wetland complex. The lacustrine wetlands behind the reservoir will be lost during reclamation. Palustrine wetlands along the channel that are fed by side slope hydrology will be maintained as much as possible. This issue will be addressed in detail during final design.

G.4 PROPOSED RESTORATION STRATEGIES AND TECHNIQUES

G.4.1 Riparian and Wetland Restoration Strategies and Techniques

This section describes the riparian and wetland restoration strategies and techniques to be applied in the restoration project area. The importance of a practical and cost-effective revegetation plan and the diligent implementation of that plan cannot be overstated nor over-emphasized. The revegetation activities will be important to the success of the overall project and ultimately meeting the objectives established for this plan. Natural channel design concepts rely on effective revegetation and existing vegetation to provide long-term bank stability; provide energy dissipation and sediment storage on floodplains; provide shade and long-term woody debris recruitment for aquatic habitat; and desired aesthetics.

This revegetation plan is conceptual in nature and provides the foundation for developing final designs. For revegetation to be successful, acknowledging the role that fluvial processes play in determining plant community structure on streambanks, floodplains, wetlands and associated uplands is necessary. Because these natural processes occur over timeframes that are somewhat unpredictable, our plan includes actions to make the processes more predictable. This document describes different components of the revegetation process that fit into the following categories.

- Influence site potential, as determined by topography, substrate, hydrology, and interactions with other biological components, by creating conditions that will support a natural, sustainable, and dynamic distribution of plant communities.
- Anticipate and manage for invasive species that are not in balance with the natural system.
- Identify appropriate plant materials that are adapted to the local area and to the different geomorphic features in the fluvial environment.
- Anticipate the need to maintain revegetated areas during their establishment period, while leaving room for the river to adjust to its new alignment and for some areas to naturally colonize.

The final design phase will include specific implementation strategies tailored to each site. The final design will include the following items.

- An implementation plan with construction phasing, detailed materials lists, and sources and quantities for plant materials.
- A detailed site grading plan that includes microtopography enhancement and creation; rock, log and brush pile placement on the floodplain; locations of off-channel wetlands, channels and drainage areas; and substrate and topsoil requirements.
- A detailed planting plan including plant mixes and specifications for planting.
- An erosion control plan for surface water and streambank erosion control.
- A monitoring and maintenance plan that includes a weed control and management plan.

This revegetation plan was developed to meet the following multiple objectives.

- Re-establish a self-sustaining native plant community in balance with fluvial processes.
- Mitigate surface erosion and associated off-site impacts.
- Restore a healthy, diverse and viable edaphic (soil) environment.
- Provide for slope and bank stability while minimizing project maintenance.
- Re-establish/enhance terrestrial, riparian and aquatic habitat for dependent species.
- Inhibit the establishment of undesirable plant species including noxious weeds.
- Post-project visuals and aesthetics.

No revegetation plan is capable of precisely replicating the pre-disturbance native plant communities. Depending on the existing vegetation and the successional stage of the plant community it may not be practical, desirable or even possible to do so. This plan is designed to "jump-start" the recovery of the complex ecologic interactions and reintroduce biological diversity to the project area following restoration activities.

The restoration project area is divided into five reaches. Within those reaches, areas were further divided into categories based on geomorphic setting and revegetation treatment differentiation. The individual areas were delineated through a combination of aerial photo interpretation, field visits and post-construction landscape position associated with the conceptual design. The categories include streambanks, floodplains, wetlands, and upland areas. Each category represents a geomorphic feature, and revegetation strategies vary by geomorphic feature. While the geomorphic features within each reach are treated slightly differently, the following descriptions are intended to place restoration strategies in the context of geomorphic features within the restoration project area.

Streambanks

Streambanks were split into depositional areas and other streambanks. Alluvial deposition areas on the inside of meander bends would be seeded with locally collected willow and cottonwood seed following runoff to mimic natural plant establishment processes. This treatment as establishes an ephemeral seed bank because seeds of these species are short-lived and germinate within a brief window that is closely tied to the river's hydrograph. These dynamic depositional areas would not be treated otherwise, except under special circumstances identified during final design.

The "outside" banks of meanders require a more rigorous revegetation treatment due to their occasional exposure to high energy stream flows. These areas would be revegetated using a combination of transplanted sod and shrubs, native seed, containerized seedlings, and bioengineered bank structures integrated with large wood and rock-based bank structures described in other sections of this document. For conceptual planning, it is assumed that streambanks are a ten-foot band along the channel; depositional areas are up to 50 ft wide.

Floodplain

The floodplain includes areas that are inundated during flood flows, but are outside the streambanks. The floodplain will be designed to be inundated with a 1.5 to 2 year return interval flood (approximately 2 out of 3 years on the average). Treatments for these areas are variable because floodplains comprise the majority of areas to be restored. Final grading will result in micro-topographic relief to create a complex floodplain surface. Much of the area should be alluvial gravel and cobble substrate, but portions of the floodplain should be covered with sand, silt loam or organic material, depending on micro-topography and distance from the river channel. Much of the floodplain will be seeded and planted with containerized seedlings. Portions of the floodplain may be amended with organic mulches to limit weed infestation and support development of biological soil components. As part of creating micro-topographic relief, some depressions will be created within the floodplain that will develop into wetland features.

Wetlands
Wetlands include the following habitat features.

- Abandoned channels that are retained after construction of the new channel.
- Depressions that are constructed within the floodplain as part of the final floodplain grading.
- Existing wetland features that will be maintained or enhanced to meet the project's no net wetland objective.

Newly constructed wetland areas should be graded with approximately 10:1 slopes on the river side and steeper slopes on the upland side. These areas should be covered with six inches to a foot of fine-textured mineral soil or organic soil. Wetlands should be seeded with the wetland seed mix, and planted with both herbaceous plugs, and containerized riparian/wetland shrubs. Revegetation will be slightly more aggressive in these areas to limit infestation by weeds and invasive plant species.

Uplands
Uplands are areas outside of the active floodplain that will be disturbed by grading and other river restoration activities. Most upland areas will be seeded and treated with either hydromulch or a thin layer of compost to enhance seed establishment and limit weed infestations. Portions of these areas will be planted with containerized shrubs and trees suited for riparian and upland areas.

General Restoration Notes
Because portions of the new channel and floodplain will be inset relative to the existing channel and floodplain, these areas will be completely bare before revegetation begins. Fifteen hundred feet upstream from Duck Bridge in CFR3, the channel will be realigned approximately at its current elevation. Within this area, only some areas will need to be completely revegetated, some areas will require plant salvage, other areas will be left intact, and other areas might require some active revegetation to enhance existing plant communities.

In the following subsections, we describe techniques for accomplishing revegetation objectives. For each technique, we describe the technique and discuss the conditions where it is appropriate to apply the technique.

G.4.2 Plant Salvage

Mature plants located in the path of new construction and grading should be salvaged wherever possible. Salvaging plants and sod can be a relatively inexpensive method for obtaining large, native, site-adapted planting stock for rapid vegetative reestablishment and bank stabilization. During final design, shrub, tree, and sod salvage areas should be identified. In addition, holding areas should be identified, and a maintenance plan should be developed that addresses duration of salvaged material storage, timing related to other construction activities, weeding, and watering. The presence of noxious weeds and invasive plant species in salvaged plant root-balls should be considered when selecting salvage stock.

Construction sequencing and activities in the Remediation Project Area in Reach CFR2 where bare sites will be the most extensive, plant salvage potential is limited. It is unlikely that there will be areas ready to plant when the plants are displaced. If timing of construction permits, some plants could be transplanted to Reach CFR3. Additional field investigation and planning is needed before plant salvage is a feasible treatment in CFR2.

G.4.3 Final Grading

Final grading of bare site areas should result in varied elevations aimed at creating micro-topographic relief and a variety of habitat niches on the floodplain. Examples floodplain features include the following site types.

- Grade surfaces, which include areas graded to a specific elevation with no microtopography or other features incorporated.
- Linear depositional features of sand and gravel oriented parallel to the river channel, approximately six inches to one foot above the floodplain elevation and 3 ft to 6 ft wide. These would be similar to windrow-like linear features naturally deposited along the Clark Fork River during high flow events. These features provide habitat for different plant species than the surrounding floodplain surface and cause smaller flood flows to scour and deposit sediment in more complex patterns than if the floodplain was graded smooth.
- Depression features, similar to abandoned oxbow features, to create wetland habitat between six inches and three feet below the floodplain surface. On the river side, these depressions should have no more than a 10:1 slope and on the opposite side, these depressions may have steeper slopes.
- Creation of bankfull benches and depositional features along the channel.

G.4.4 Substrate Variation

Rather than covering bare floodplain sites with a uniform layer of topsoil, substrate should be varied. This includes incorporating areas of exposed gravel and cobble, layers of sand, and areas of silt loam or organic material into the new floodplain. Gravel/cobble should be the original fill material, sand should be placed in patches on gravel/cobble surfaces, and finer-textured material should be placed six to twelve inches deep in depressions. Final designs will show locations of different substrates and mulching, seeding, and planting plans should correspond to substrate polygons.

For bare upland sites, revegetation will probably occur on native soils. However, these areas may require surface amendments including topsoil application, a thin layer of hydraulically-applied compost, or hydromulching for steeper slopes.

G.4.5 Weed Management

Weed management should be incorporated as part of site preparation and revegetation actions. The primary weed species have broader substrate and moisture tolerances than most of the native

plant species, and they are very tolerant of disturbance; therefore, weed management on bare sites will be particularly challenging. Spotted knapweed will likely colonize higher and coarser areas within the floodplain. Tansy will likely occupy sandier areas at the active floodplain elevation. Reed canarygrass will occupy all areas within the floodplain, but will become particularly dense on finer-textured soils around the perimeter of depressions.

A well-established native plant community is more likely to resist weed invasion. Post-construction, several weed management strategies should be implemented. In planted areas, selective weed management methods should be used to minimize damage to newly planted and seeded materials. Selective weed control methods include, manual removal (hand pulling, digging, or cutting) and spot herbicide applications (backpack sprayer or wick applications). Weed management activities should continue annually for three to five years following project completion.

All seed, organic material, and other material brought onto the site will need to meet State weed-free requirements. Risk of spreading weeds will be addressed in several ways. Specifications will address specific materials. All materials delivered to the site will be inspected for quality and to assess whether they meet specifications; and construction best management practices will provide guidelines for washing equipment to avoid transfer of undesirable seed to the project area.

It is inevitable that these weed species will infest new floodplain surfaces to some degree. However, it will be possible to prevent the new floodplain surfaces from becoming monotypic weed communities by aggressively promoting colonization of bare substrate by desired native plant species. Methods for promoting native plant species establishment on bare sites include the following techniques.

- Establish a native seed bank.
- Occupy available niches by seeding and planting desired plant species.
- Create a complex floodplain surface.
- Use a coarse, organic mulch in areas away from the channel.
- Actively manage vegetation by controlling weeds and maintaining newly seeded and planted areas.

These methods are described in greater detail in the following subsections.

G.4.6 Seeding

The revegetation effort would also include up to five native seed mixes that would be specific to landform and edaphic conditions. Seed mixes include: wetlands (including ephemeral and long-term seed bank mixes), streambanks, floodplain, and upland terraces. Availability of seed will determine the number of seed mixes that will be possible to create for the project. Seed mixes will consist of both grass and forb species. Using a mix of grasses and forbs will occupy a wider range of microsites and soil strata and help to reduce availability of open sites for weedy species to germinate and become established.

Seed quantity is specified for a site in "pure live seed pounds per acre." Bulk pounds, or actual seeding rate to be applied in the field will depend upon the amount of debris and other inert matter in the given seed lots. Depending upon seeding method and species, the mix may need to be pre-mixed. In some cases, seeding may be done in two phases (two growing seasons) to facilitate simultaneous weed control efforts and/or plant diversity enhancements tied to groundwater depths.

Upland Seed Mix

The upland seed bank mix will be used in newly created uplands in Reaches CFR2 and 3. The upland seed mix consists of native bunchgrasses, faster-establishing varieties of native grass, and native forbs (Table G-2). The native varieties will provide initial seed-generated coverage. The native bunchgrass seeds will act as a seed bank for future plant re-generation. The mix of grasses and forbs will ideally occupy more of the available niches in the upland areas, preventing the establishment of non-native weedy species.

Table G-2. Upland planting zone seed mix species.

Common Name	Scientific Name	Life Form	Description
Mountain brome	*Bromus marginatus*	Graminoid	A cool season short lived perennial, adapted to a wide spectrum of moist soils but intolerant of high water tables
Sheep fescue	*Festuca ovina*	Graminoid	Cool season perennial
Slender wheatgrass	*Elymus trachycaulus*	Graminoid	Cool season perennial, saline tolerant, wide range and drought tolerant
Bluebunch wheatgrass	*Pseudoroegenaria spicata*	Graminoid	Cool season perennial, drought tolerant
Idaho fescue	*Festuca idahoensis*	Graminoid	Cool season perennial
Prairie junegrass	*Koeleria cristata*	Graminoid	Cool season perennail, establishes easily
Needle and thread	*Stipa comata*	Graminoid	Cool season perennial, used extensively for revegetating disturbed sites or blowout areas
Common yarrow	*Achillea millefolium*	Forb	
Pacific aster	*Aster chilensis*	Forb	Low to moderate water requirement
Fireweed	*Epilobium angustifolium*	Forb	
Blue flax	*Linum lewisii*	Forb	Drought tolerant
Silky lupine	*Lupinus sericeus*	Forb	

Floodplain Seed Mix

The floodplain seed mix will be used in the newly created active floodplain, outside of the streambanks in Reaches CFR2 and 3. The floodplain seed mix consists of native grasses and forbs adapted to a moist water regime (Table G-3). The mix includes some rapidly establishing

species that provide fast coverage over the site and some desired native species to provide a seed bank for future plant re-generation. The mix of grasses and forbs will ideally occupy more of the available niches in the floodplain, preventing the establishment of non-native weedy species.

Table G-3. Floodplain planting zone seed mix species.

Common Name	Scientific Name	Life Form	Description
Streambank wheatgrass	*Agropyron riparium*	Graminoid	Cool season perennial, drought-tolerant, rhizomatous, occupies slightly wetter sites
American sloughgrass	*Beckmannia syzigachne*	Graminoid	Cool season perennial
Bluejoint reedgrass	*Calamagrostic canadensis*	Graminoid	Cool season perennial
Tufted hairgrass	*Deschampsia caespitosa*	Graminoid	Cool season perennial, moist sites but also on drier sites in its upper limit
Slender wheatgrass	*Elymus trachycaulus*	Graminoid	Cool season perennial, saline tolerant, wide range and drought tolerant
Fowl mannagrass	*Glyceria striata*	Graminoid	Cool season perennial, slow streams, often associated with coniferous woods and willow thickets, prefers areas of seasonal flooding, spreads rapidly, good for streambank stabilization
Common yarrow	*Achillea millefolium*	Forb	
Pacific aster	*Aster chilensis*	Forb	Low to moderate water requirement, can be drought tolerant
Fireweed	*Epilobium angustifolium*	Forb	
Rocky Mountain penstemon	*Penstemon strictis*	Forb	Low to moderate water requirement, full sun to partial shade

Streambank Seed Mix

The streambank seed mix will be used on newly created, non-depositional streambanks throughout the restoration project area. The mix consists of species typically adapted to a wet water regime, with some drought-tolerant species (Table G-4).

Table G-4. Streambank planting zone seed mix species.

Common Name	Scientific Name	Life Form	Description
Streambank wheatgrass	*Agropyron riparium*	Graminoid	Cool season, drought-tolerant, rhizomatous, occupies slightly wetter sites
Bluejoint reedgrass	*Calamagrostic Canadensis*	Graminoid	Cool season
Slender wheatgrass	*Elymus trachycaulus*	Graminoid	Cool season, saline tolerant, wide range and drought tolerant
Fowl mannagrass	*Glyceria striata*	Graminoid	Cool season, slow streams, often associated with coniferous woods and willow thickets, pefers areas of seasonal flooding, spreads rapidly, good for streambank stabilization
Common yarrow	*Achillea millefolium*	Forb	
Wild licorice		Forb	Seed is expensive and the species may naturally establish from upstream seed sources
Fireweed	*Epilobium angustifolium*	Forb	

Ephemeral Seed Mixes

The ephemeral seed mix will be an opportunistic collection of seed from native species of trees and shrubs growing in or adjacent the restoration project area. Possible species would include black cottonwood, sandbar willow, and other willow species.

Wetland Seed Mixes

The wetland seed mix will be used in newly created wetland areas located in abandoned river channels in the floodplain and uplands throughout the restoration project area. The wetland seed mix consists of a mix of some rapidly establishing species and a mix of long-term viable native species to act as a seed bank in these newly created areas (Table G-5). Some of the species are drought-tolerant, intended to occupy slightly drier microsites within the wetlands. Including drought-tolerant species will help to prohibit the invasion of non-native weedy species by preemptively occupying these sites.

Table G-5. Wetland planting zone seed mix species.

Common Name	Scientific Name	Life Form	Description
American sloughgrass	*Beckmannia syzigachne*	Graminoid	Cool season
Water sedge	*Carex aquatilis*	Graminoid	Cool season, seed bank
Bebb's sedge	*Carex bebbii*	Graminoid	Cool season, seed bank
Nebraska sedge	*Carex nebraskensis*	Graminoid	Cool season, colonizer
Beaked sedge	*Carex rostrata*	Graminoid	Cool season
Tufted hairgrass	*Deschampsia caespitosa*	Graminoid	Cool season perennial, moist sites but also on drier sites in its upper limit
Creeping spikerush	*Eleocharis palustris*	Graminoid	Cool season rhizomatous perennial
Fowl mannagrass	*Glyceria striata*	Graminoid	Cool season, slow streams, often associated with coniferous woods and willow thickets, pefers areas of seasonal flooding, spreads rapidly, good for streambank stabilization
Baltic rush	*Juncus balticus*	Graminoid	Cool season, colonizer
Poverty rush	*Juncus tenuis*	Graminoid	Cool season moist disturbed areas or compacted soils
Torrey's rush	*Juncus torreyi*	Graminoid	Cool season, prefers saturated soil but will also tolerate periods of drought
Hardstem bulrush	*Scirpus acutus*	Graminoid	Cool season, standing water or wet muddy soils
Streambank wheatgrass	*Agropyron riparium*	Graminoid	Cool season, drought-tolerant, rhizomatous, occupies slightly wetter sites
Bluejoint reedgrass	*Calamagrostic canadensis*	Graminoid	Cool season
Slender wheatgrass	*Elymus trachycaulus*	Graminoid	Cool season, saline tolerant, wide range and drought tolerant
Common yarrow	*Achillea millefolium*	Forb	
Pacific aster	*Aster chilensis*	Forb	Low to moderate water requirement, can be drought tolerant
Fireweed	*Epilobium angustifolium*	Forb	

Methods for seeding

Methods for seeding include hand broadcast seeding, hand broadcast seeding followed by hydromulching, and applying seed as part of a compost slurry (terra seeding). The following section details these methods.

Broadcast seeding is accomplished by a person walking through an area with a front-mounted spinner-spreader device. Seed can be spread in approximately 12 ft bands in one pass. On flat ground one person can seed between one and two acres in an hour. Depending upon substrate, broadcast seed can either be raked in or otherwise integrated into the soil surface using a harrow pulled behind a four-wheeler. Broadcast seeding alone will be effective in most floodplain areas if seed is applied when there is sufficient moisture at the soil surface.

Hydromulch is applied directly over broadcast seed as a water-based slurry. It is possible to mix seed directly into the hydromulch (hydroseeding), but seed tends to become suspended in the slurry, which keeps it from directly contacting the soil surface. Hydromulching can limit soil erosion, hold seed in place, and help maintain moisture at the soil surface. Hydromulching should be used in floodplain areas if seed needs to be applied during late spring or early fall when floodplain conditions are likely to be hot and dry. Otherwise, hydro-seeding is generally not cost-effective on slopes with less than a 3:1 slope. On steeper upland slopes, either hydromulching or terra seeding will be the best methods for applying seed.

Terra seeding is a method where seed is applied within a compost slurry. Seed is actually planted rather than exposed on the surface, eliminating the need for a tackifier. By incorporating seed into a thin organic substrate, seed can quickly and vigorously germinate, reducing niches available for weeds.

Seed bank development

For the purposes of this conceptual plan, there are two kinds of seed banks: long-term and ephemeral. The long-term seedbank will consist of long-lived seeds of herbaceous wetland plants and later successional riparian shrubs. These seeds should be broadcast primarily in depressions and, to a lesser degree, on the active floodplain surface. The ephemeral seed bank will be willow and cottonwood seeds that should be collected annually in the spring and directly distributed on depositional features to increase the chances that seed will be present in sufficient quantities when conditions for germination and establishment are ideal. Ideal conditions for germination occur on the declining limb of spring runoff when depositional bars are exposed yet still moist. Naturally, willows and cottonwoods germinate on these features only during years when runoff timing coincides with wind-driven and water-driven seed dispersal. By collecting seed, it will be possible to control when and where seeds are dispersed as a way to increase the likelihood of natural colonization. Seed collection and handling practices will be covered in the final restoration design.

G.4.7 Plant Materials for Restoration

Trees and shrubs used in the restoration project area would be containerized native plants with an established root system. The plants should be grown in a 3 inch diameter by 14 inch long (minimum) up to 36 inch long containers or in one tall one-gallon containers, measuring 4 inches x 4 inches x 14 inches. Herbaceous species would be grown in smaller containers. Cuttings would be limited to native willow species harvested from on-site and/or nearby areas. Cuttings should be approximately 40 inches in length and 0.5 inches to 0.75 inches in diameter. Cuttings would be planted so the basal end is submerged in or very near groundwater for the majority of the year, this would increase their survival rate.

Willow Cutting Harvest and Preparation Guidelines

- Willow cuttings should be collected locally.
- Install willow cuttings in late March or early April, preferably on the same day they are harvested. If not planted on the same day, the cuttings could be soaked until the following day.
- Collect willow cuttings from second-year stems taken from healthy plants while they are dormant (during winter/early spring).
- If cuttings must be stored, store cuttings for no more than two weeks and keep moist and shaded.
- Plant willow cuttings so at least three-quarters of their length is buried in soil and ensure that at least two or three buds are exposed.

Wetland Plant Mix

The wetland plant mix will be used in newly created and abandoned off-channel wetlands in the floodplain or upland planting zone (Table G-6). The potential natural community is a willow, alder, or birch dominated habitat type.

Table G-6. Wetland plant mix species.

Plant Species	Common Name
Containerized shrubs	
Alnus incana	Mountain alder
Betula occidentalis	Water birch
Cornus stolonifera	Red osier dogwood
Salix boothii	Booth willow
Salix exigua	Sandbar willow
Salix drummondiana	Drummond's willow
Salix bebbiana	Bebb's willow
Sambucus cerulean	Blue elderberry
Rosa woodsii	Woods' rose
Symphoriocarpos spp.	Snowberry
Herbaceous Plugs	
Carex aquatilis	Water sedge
Carex utriculata	Beaked sedge
Carex vesicaria	Inflated sedge
Eleocharis palustris	Common spikesedge
Juncus balticus	Baltic rush
Juncus ensifolius	Dagger-leaf rush

Floodplain Plant Mix

The floodplain plant mix will be used in newly created floodplain areas within the active floodplain. The potential natural community is deciduous tree, black cottonwood or quaking aspen, dominated plant community. The mix also contains shrubs to create an understory layer

of woody vegetation (Table G-7). The final design for the floodplain planting will be further broken down to accommodate final grading and microtopography of the floodplain.

Table G-7. Floodplain plant mix species.

Plant Species	Common Name
Containerized trees	
Pinus ponderosa	Ponderosa pine
Populus trichocarpa	Black cottonwood
Populus tremuloides	Quaking aspen
Containerized shrubs	
Alnus incana	Mountain alder
Amelanchier alnifolia	Western serviceberry
Betula occidentalis	Water birch
Cornus stolonifera	Red-osier dogwood
Crataegus douglasii	Black hawthorn
Prunus virginiana	Common chokecherry
Ribes spp	Wild currant
Rosa woodsii	Woods' rose
Rubus idaeus	Red raspberry
Salix bebbiana	Bebb willow
Salix exigua	Sandbar willow
Salix drummondiana	Drummond willow
Sambucus cerulea	Blue elderberry
Symphoriocarpos spp	Snowberry

Streambank Plant Mix

The streambank planting mix will be used on newly created, non-depositional streambanks throughout the restoration project area. The plant mix consists of shrubs that develop deep binding root masses that are able to withstand flood flows (Table G-8). Herbaceous plugs are also included in the mix to stabilize the upper soil layers of the streambanks. The potential natural community is Sandbar willow Community Type.

Table G-8. Streambank plant mix species.

Plant Species	Common Name
Containerized shrubs	
Cornus stolonifera	Red-osier dogwood
Salix drummondiana	Drummond's willow
Salix exigua	Sandbar willow
Salix lutea	Yellow willow
Herbaceous Plugs	
Carex aquatilis	Water sedge
Carex utriculata	Beaked sedge
Carex vesicaria	Inflated sedge
Eleocharis palustris	Common spikesedge
Juncus balticus	Baltic rush
Juncus ensifolius	Dagger-leaf rush

Upland Plant Mix

The upland plant mix will be used in newly created uplands (Table G-9). Uplands are located outside of the active floodplain and may contain lower elevation microsites with wetlands (planted with the wetland plant mix). The uplands may have some groundwater influence and will represent an upland floodplain terrace. The potential natural community is ponderosa pine/red osier dogwood (*Pinus ponderosa/Cornus stolonifera*) Habitat Type or Douglas fir/red osier dogwood (*Pseudotsuga menziesii/ Cornus stolonifera*) Habitat Type.

Table G-9. Upland plant mix species.

Plant Species	Common Name
Containerized trees	
Pinus ponderosa	Ponderosa pine
Populus trichocarpa	Black cottonwood
Pseudotsuga menziesii	Douglas-fir
Populus tremuloides	Quaking aspen
Containerized shrubs	
Acer glabrum	Rocky Mountain Maple
Alnus incana	Mountain alder
Amelanchier alnifolia	Western serviceberry
Crataegus douglasii	Black Hawthorne
Philadelphus lewisii	Mockorange
Prunus virginiana	Common chokecherry
Ribes spp	Wild currant
Rosa woodsii	Wood's rose
Rubus idaeus	Red raspberry
Salix bebbiana	Bebb willow
Sambucus cerulean	Blue elderberry
Symphoriocarpos spp	Snowberry

G.4.8 Planting Strategies and Methods

Planting Methods

Plants should be installed so roots are straight, and the root crown is level with or slightly below the surrounding soil surface. As part of the final design phase, specific planting methods should be identified for groups of plant species. For example, willow and rose family plants can be planted with stems partially buried. Alternatively, pine family plants must be planted so that the root crown is even with the soil surface. Planting methods should ensure that air pockets are eliminated during planting. Each plant should be secure enough in the ground to resist a firm tug.

Containerized Plants

If tall 1 gallon containerized shrubs are used, an auger attachment to a rubber-tracked Positrack or similar equipment should be used to bore an 8 inch diameter hole into the substrate. Alternatively, a two-person handheld auger can be used in finer-textured soils.

If an excavator-mounted hydraulic stinger attachment is available, this method should be used to plant some gravel and most cobble areas. A person should follow behind the machine to ensure that planting holes are filled properly and that there are no air pockets.

Smaller containerized plants should be planted by hand by crews using hoedads who are experienced working with native plant species. Regardless of the planting method, all plants should be watered immediately after planting to improve soil contact around roots and to limit air pockets in the planting holes.

Mature Shrub Transplants

Where mature shrubs are transplanted, planting holes should be dug with a backhoe bucket, excavator bucket or tree spade to accommodate the root ball.

Willow Stakes

Willow stakes should be planted either using an excavator-mounted hydraulic stinger attachment, or by piloting holes using an electric impact hammer with a 5/8 inch bit.

Browse protectors

Browse protectors should be installed around shrubs and trees, in protected areas of the floodplain, to prevent herbivory. Browse protectors should be 3 ft to 4 ft high and 8 inches to 10 inches diameter for 1 gallon planted shrubs, and browse protectors should be constructed using a rigid mesh material that will resist wear and not rapidly photo-degrade. Plants near the channel should not receive browse protectors, but should be sprayed with a browse repellent and monitored to evaluate whether repeat applications are necessary.

G.4.9 Bioengineering Techniques

These techniques mix living plant material with nonliving materials selected for their physical properties. These techniques evolved in response to the need to stabilize soil at the land-water interface long enough for vegetation to become established. Three types of bioengineering

techniques are proposed in this conceptual restoration plan; geotextile soil lifts, pre-fabricated vegetated gabions and pre-vegetated coir mats. These techniques should be used at the land-water interface in areas where establishing vegetation quickly is a priority.

Geotextile Soil Lifts

Geotextile soil lifts, also called fabric-encapsulated lifts or vegetated geogrids, can be installed to hold banks as vegetation reestablishes in areas where the banks of the river are dominated by finer materials such as soil and gravel. One or more soil levels, 6 inches to 18 inches deep, are constructed in sequence, each stepped slightly back and faced with one or more layer of erosion control fabric. Seed is applied under the fabric, and the fabric is commonly made of woven coir. The fabric is keyed between each layer, and cuttings, stakes, and plants are installed to further anchor the structure.

Pre-vegetated Coir Mats

Pre-vegetated coir mats are 3 inch thick mattresses of coconut fiber (coir) inside a woven coir fabric. Mattress dimensions are approximately 3 ft x 15 ft. Herbaceous wetland plants are grown into the coir matrix in a nursery, and the mattress is shipped as a roll, installed on bare soil, and secured with triangular wooden stakes.

G.4.10 Soil Amendments

Site preparation and revegetation strategies in this conceptual plan include some techniques for varying topography and substrate to mimic how natural processes create a complex matrix of substrate. Soil amendments, in the context of native plant revegetation, are typically aimed at either adding nutrients or changing the texture or organic matter composition of soil surfaces. Riparian areas are natural nutrient transport zones, so nutrients will move in and out of the system without assistance from scientists. Further, because native plants are adapted to lower levels of available nutrients than non-native plant species, adding nutrients might give invasive plants a competitive edge.

Revegetation plans also often include methods for adding beneficial soil microbes including mycorrhizae. During final design, the need to add nutrients or soil microbes should be evaluated carefully. However, because sources of nutrients and mycorrhizae are probably present in the surrounding ecosystem, they are not included as specific treatments within the conceptual plan.

G.4.11 Large Wood

Because weeds thrive on simple, uniform surfaces, one strategy to limit weed infestation will be to create a complex surface. This can be accomplished by varying final grading and substrate as described above. In addition, large logs and woody debris piles can be distributed throughout the floodplain to create micro-sites and stimulate biological development within the soil.

G.4.12 Organic Mulches

Soils naturally protect themselves from erosion by accumulating thin layers of organic debris. The organic debris provides a food source for soil organisms. Resulting fungal nets on the soil

surface, and biological activity within the rooting zone, can stabilize soils and limit weed infestations. While applying mulch would not be appropriate within areas that are frequently flooded by the river, a two-inch thick layer of either wood chips or conifer needles from native tree species should be applied in some bare soil areas less likely to be scoured by overbank flows.

G.4.13 Erosion Control

Many aspects of the revegetation plan will result in relatively stable soils, in addition to meeting other revegetation objectives. For example, seeding, revegetation, and mulching all contribute to limiting erosion. Because erosion control is addressed indirectly, this plan does not describe specific erosion control methods. It is also important to consider that erosion is a necessary and natural process in an alluvial river system, so there needs to be some allowance for alluvial material to be redistributed by the river.

G.4.14 Maintenance and Monitoring

During the first two years, bare site areas should be closely managed to limit weed infestations and maintain seeded and planted areas. Based on our experience, two years is approximately how long it takes for a site to stabilize and begin to reflect its early vegetative potential. Methods for maintenance, monitoring and management are described in G.4.16.

Some weeds can be hand-pulled with only a few person days worth of effort, in other areas where severe weed infestations occur, it may be necessary to use aggressive weed control measures and essentially start over with revegetation once weeds have been suppressed.

Even though floodplains are within a functional wetland environment, they can be extremely dry during portions of the growing season. During the first two growing seasons, all planted seedlings should be monitored for soil moisture, and deep watered to saturate the rooting zone if needed. Some seeded areas should be watered using broadcast irrigation to maximize germination and thus limit available niches for weeds.

A monitoring and maintenance plan should be developed during the final design. That plan will address weed management (including aggressive weed control), water supply and irrigation, performance standards and further specific adaptive management strategies.

G.4.15 Project Oversight

Revegetation should be coordinated in the field by an experienced revegetation specialist working closely with the fluvial geomorphologist. The revegetation specialist will be responsible for coordinating with the fluvial geomorphologist as well as overseeing the planting crews.

G.4.16 Monitoring and Adaptive Management

Monitoring

Monitoring should be aimed at determining maintenance needs and progress toward the desired condition. Monitoring may also include noting the presence and abundance of noxious vegetation, particularly where weeds have been treated within the restoration project area. Monitoring at the site will be used to develop adaptive management strategies for weed control.

Adaptive Management

Because plant community restoration is a long-term process, the overall project plan should allow for continued adaptation of the project maintenance plan based on monitoring results. Practically, this means budgeting a total of 10 to 20 percent of the overall revegetation cost for maintenance to be spread out over a five to ten year period after the project is initially constructed.

G.5 REACH-SPECIFIC RESTORATION PROPOSALS

G.5.1 Reach CFR1

The restoration strategy in Reach CFR 1 includes changing the elevation of the island in the middle of CFR channel, narrowing the channel, and creating a bankfull bench along the channel. The revegetation strategy includes salvaging the native shrub vegetation from the island prior to re-grading (Table G-10). New areas of floodplain will be created on the downstream side of the island and on the north side of the CFR downstream of the confluence of the CFR and BFR (Figure G-2). The substrate in the new floodplain areas will consist of sand in most areas and a sand-loam mixture in lower elevation depressions created during final grading. The floodplain seed mix and planting mix will be used in these areas. Approximately 30 percent of the floodplain will be mulched with mulch treatments restricted to areas not prone to annual flooding. A streambank depositional area will be created on the north bank of the CFR at the confluence. The substrate will consist of gravel and cobbles with floodplain elevation grading combined with windrow areas. Depositional areas will not be planted and will be seeded using the ephemeral seed mix strategy. Other streambank areas will have substrate consisting of a sand and loam mixture on a bankfull bench. Streambanks may also have bioengineering structures consisting soil lifts or large woody debris. The streambank seed bank and planting mix will be used in these areas. Large wood debris will be placed in both the floodplain and steambank depositional areas. Large wood will not be used on the surfaces in other streambank areas.

Table G-10. The revegetation strategy for Reach CFR1.

Feature	Area (acres)	Salvage	Substrate	Seed	Grading	Mulch	Plants	Bio-engineering	LWD
Floodplain	6.1	Yes	S/L	FP	FP/D	30%	Flood-plain Mix	No	Yes
Streambank Depositional	5.7	No	G/C	Eph	FP/W	No	No	No	Yes
Streambank Other	5.8	No	S/L	SB/ Eph	BF Bench	No	Stream-bank Mix	Soil Lifts or Woody Debris	No

For Table G-10 through G-13, refer to Secion G.4 for specific treatments related to the selected strategy. For example, for Floodplain Features, under Substrate, "S/L" refers to silt/loam; under Seed, "FP" refers to floodplain mix; under Grading, FP/D refers to floodplain/depressions.

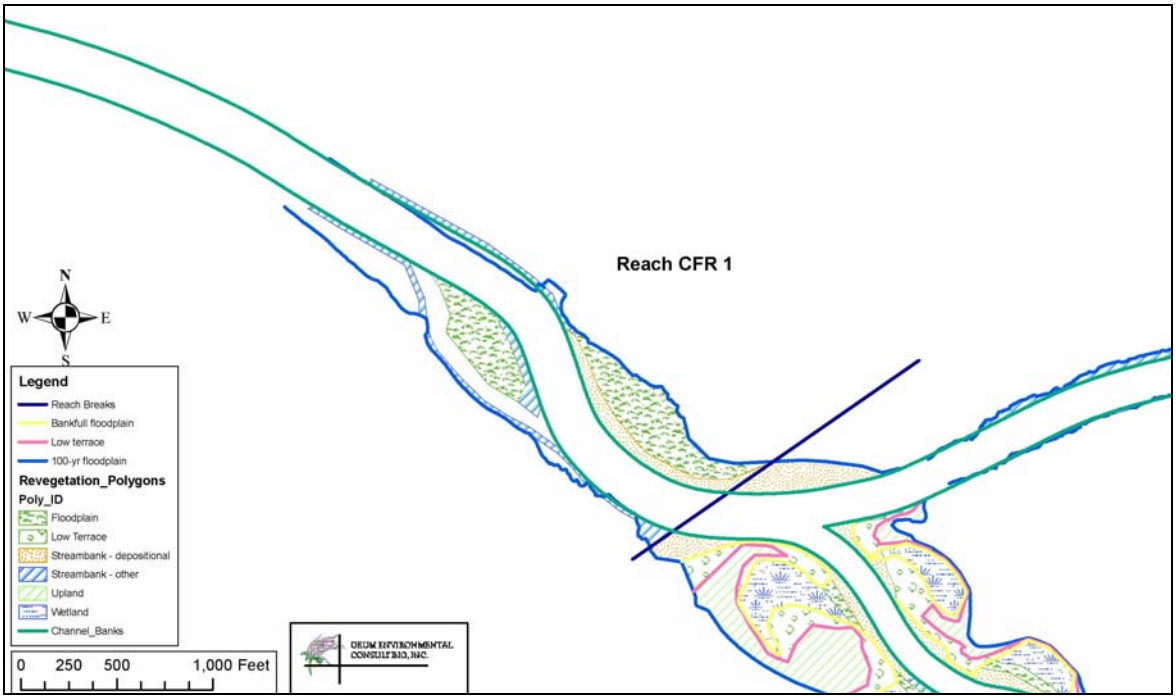


Figure G-2. Draft revegetation polygons for CFR1 and BFR1 in the confluence area.

G.5.2 Reach CFR2

The restoration strategy in CFR2 includes removing sediment from the channel and reservoir to create a new channel elevation and narrower channel (Table G-11). Re-grading work will begin long enough before revegetation work so that salvaging and preserving existing plant material may not be feasible. The revegetation strategy will result in new areas of floodplain, streambank including depositional areas, wetland, and upland in Reach CFR2 (Figure G-3 and Figure G-4). Floodplain consists of areas in the active floodplain outside of the streambanks. Final grading will create a floodplain elevation with some depressions. A sandy substrate will be used to create the floodplain and a loam mixture will be used in the depressions. Approximately 30 percent of the floodplain will be mulched in non-floodprone areas. The floodplain seed mix and plant mix will be used in these areas.

Depositional streambank areas will be graded up to the floodplain elevation using gravel and cobble substrate and will also contain windrow areas. Depositional areas will not be mulched or planted and will be seeded using the ephemeral seed mix strategy. Other streambanks will be graded to the bankfull bench elevation and the substrate will consist of sand. Bioengineering structures consisting of soil lifts or woody debris may be used along stretches of these streambanks. Other streambank areas will be planted and seeded using the streambank seed and plant mixes. Wetlands will be created in both the upland and floodplain areas of CFR2. Wetlands will be graded to depressions with loamy soils. Prevegetated coir mats may be used around the edges of some of the wetland and the wetlands will be seeded and planted using the

wetland seed and planting mixes. Uplands will be created outside of the active floodplain, adjacent to the floodplain. These areas will be graded to the upland elevation and consist of a sand to loam substrate. Approximately 30 percent of the upland area will be mulched. Uplands will be seeded and planted using the upland seed and plant mixes. Large wood will be placed on the surface in the floodplain, wetlands and uplands to add roughness and create microsites.

Plant salvage may be infeasible for CFR2 due to timing constraints. There will not be any areas ready for planting in CFR2 when the plants are disturbed. Additional site investigation is necessary before salvage could be accomplished. If timing of construction of CFR3 permits, some plants may be transplanted to the upstream reach.

Table G-11. The revegetation strategy for Reach CFR2.

Feature	Area (acres)	Salvage	Substrate	Seed	Grading	Mulch	Plants	Bio-engineering	LWD
Floodplain	32.3	No	S/L	FP/ Eph	FP/D	30%	Flood-plain Mix	No	Yes
Streambank Depositional	20.0	No	G/C	Eph	FP/W	No	No	No	Yes
Streambank Other	5.0	No	S	SB	BF Bench	No	Stream-bank Mix	Soil Lifts or Woody Debris	No
Wetland	13.3	No	L	Wet-land Mix	D	40%	Wetland Mix	Pre-Vegetated Coir Mats 10%	Yes
Upland	47.8	No	S/L	Upland Mix	Upland/ D	30%	Upland Mix	No	Yes

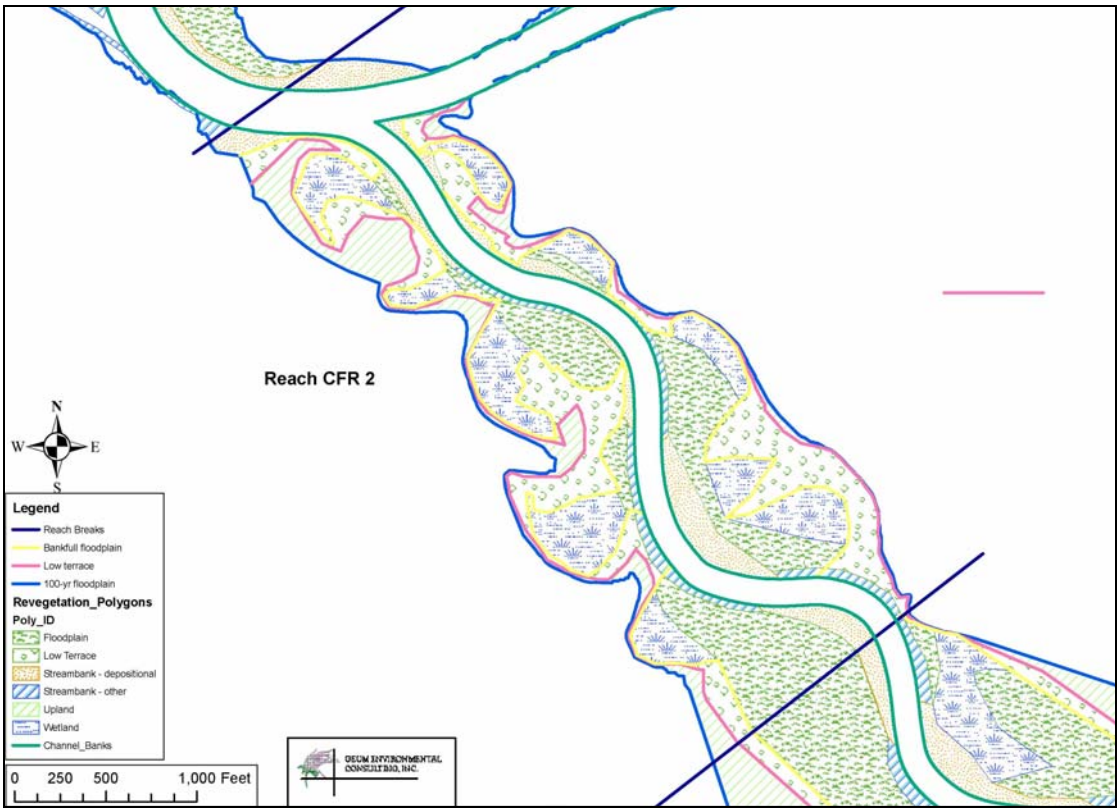


Figure G-3. Draft revegetation polygons for CFR2.

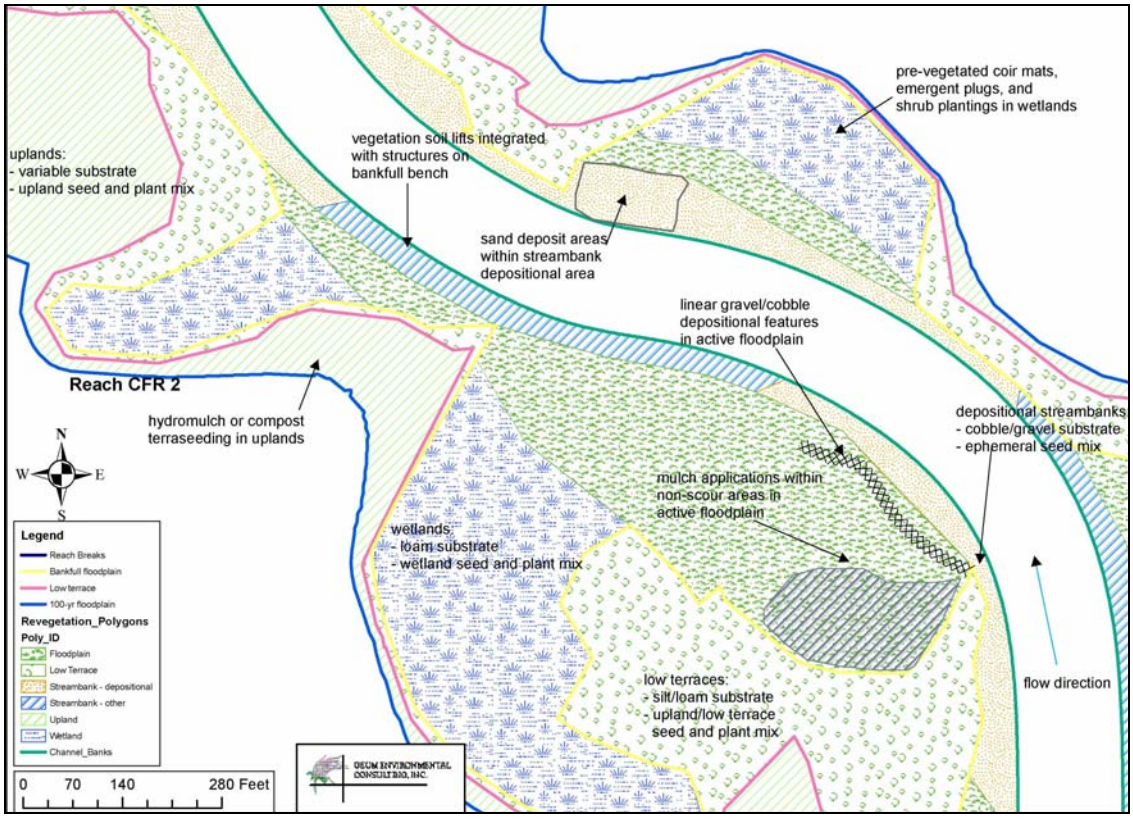


Figure G-4. Draft revegetation polygons and related substrate treatment examples for CFR2.

G.5.3 Reach CFR3

The restoration strategy in the downstream portion of Reach CFR3 includes removing sediment from the existing channel and floodplain to create a new channel elevation and narrower channel. The restoration strategy in the upstream portion of CFR3 is to create a narrower, more sinuous channel and a narrower active floodplain. Approximately eight acres of new floodplain will be created in the downstream portion of the reach (Table G-12). This area will be graded to the floodplain elevation with some depression (Figure G-5). Figure G-6 covers the CFR upstream study area (labeled as CFR4). Substrate in the floodplain will consist of sand with loam in the depressions. Non-floodprone areas of the newly created floodplain will be mulched. The floodplain seed and plant mix will be used in the newly created areas of floodplain only. New streambanks will be created throughout the reach. Depositional streambanks will be graded up to the floodplain elevation and consist of a gravel and cobble substrate. The ephemeral seed mix and strategy will be used in these areas. Other streambank areas will be graded to the bankfull bench elevation and have a sandy substrate. Bioengineering structures consisting of soil lifts or woody debris may be used along stretches of the non-depositional streambanks. Other streambank areas will be seeded and planted using the streambank seed and plant mixes. Wetlands will be created in the newly created areas of floodplain and upland. Abandoned channel features in the upstream portion of the reach will also be converted to wetlands. Wetland may be either be graded or filled to the depression elevation. A loam substrate will be applied in these areas and the wetland seed and plant mixes will be used. Pre-vegetated coir mats may be used on the outside edges of the wetlands. Uplands will be created outside of the active floodplain in the downstream portion of the reach where sediments will be removed. Uplands will be graded to the upland elevation and will consist of a sand or loam substrate. The upland seed and planting mixes will be used in these areas. Large wood will be placed on the surface in the floodplain, depositional streambanks, wetlands, and uplands to add roughness and create microsites.

Table G-12. The revegetation strategy for Reach CFR3.

Feature	Area (acres)	Salvage	Substrate	Seed	Grading	Mulch	Plants	Bio-engineering	LWD
Floodplain (8 acres will be bare ground)	160.0	Yes (8 ac)	S/L (8 ac)	FP (8 ac)	FP/D (8 ac)	30% (8 ac)	Floodplain Mix (8 ac)	No	Yes
Streambank Depositional	26.2	Yes	G/C	Eph	FP/W	No	No	No	Yes
Streambank Other	19.0	Yes	S/L	SB/Eph	BF Bench	No	Stream-bank Mix	Soil Lifts or Woody Debris	No
Wetland	38.0	Yes	L	Wetland Mix	D	40%	Wetland Mix	Pre-Vegetated Coir Mats 10%	Yes
Upland	33.1	Yes	S/L	Upland Mix	Upland/ D	30%	Upland Mix	No	Yes

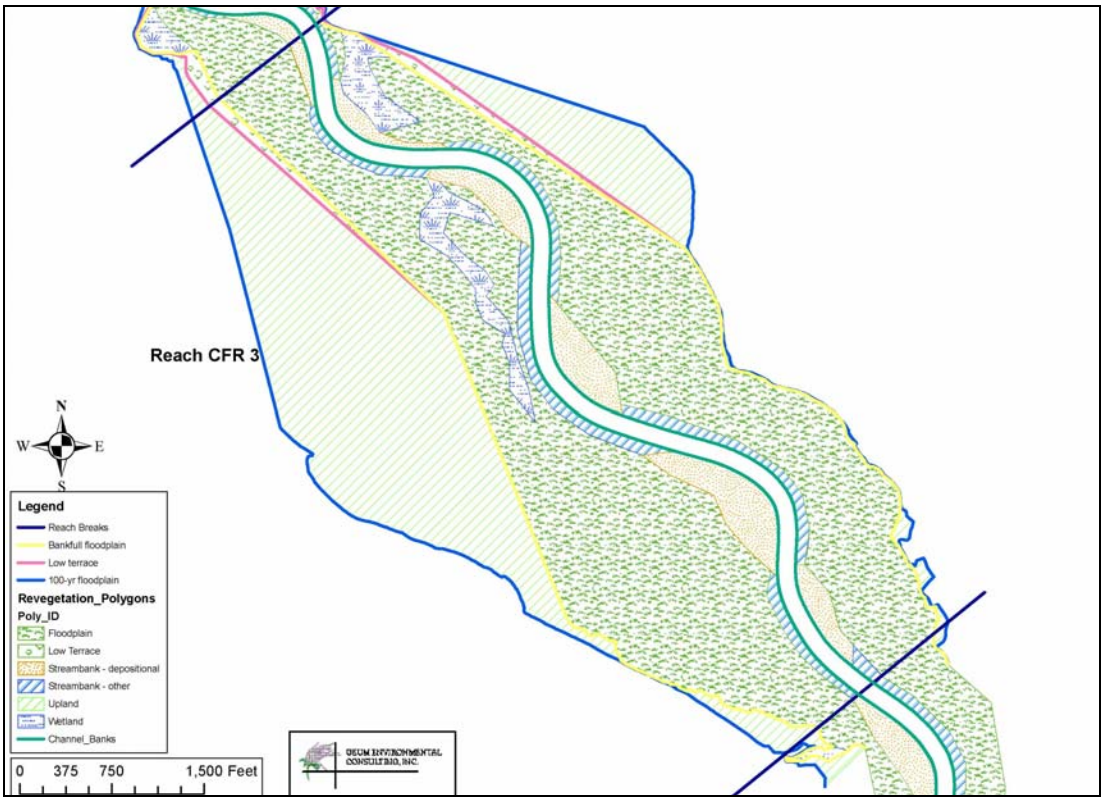


Figure G-5. Draft revegetation polygons for CFR3.

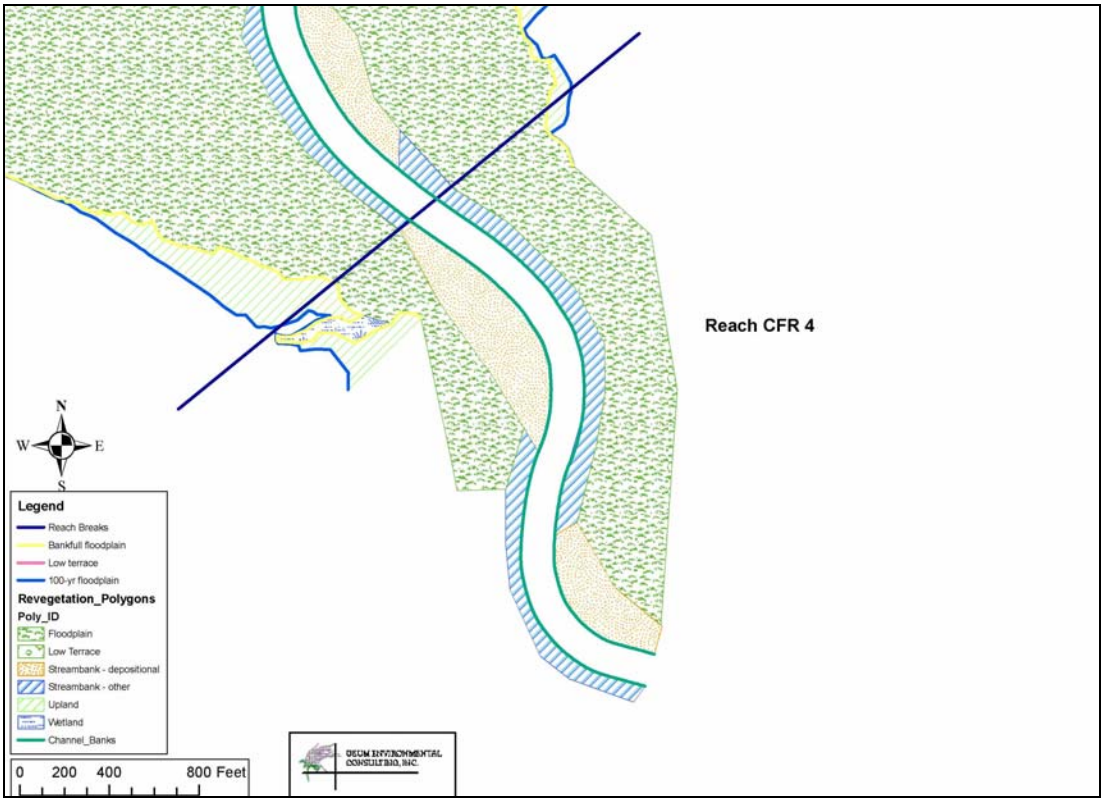


Figure G-6. Draft revegetation polygons for the CFR upstream study reach (labeled CFR4).

G.5.4 BFR1

The restoration strategy in Reach BFR1 will convert the existing open water reservoir to a narrower moderately-entrenched channels. The reconstructed floodplain in Reach BFR1 will consist of a narrow floodplain surface adjacent to the channel. Existing native vegetation along the currently banks will be salvaged and moved to the newly created bank edge. New streambanks will be created at a bankfull bench to floodplain elevation throughout the reach but are considered part of the floodplain in the reach. New substrate throughout the reach will consist of sand, gravel and cobbles. The floodplain seed and plant mix will be used throughout the reach without any mulch (Table G-13 and Figure G-7). No bioengineering structures are proposed. Large wood will be placed on the floodplain surface to add roughness and create microsites.

Table G-13. The revegetation strategy for Reach BFR1.

Feature	Area (acres)	Salvage	Substrate	Seed	Grading	Mulch	Plants	Bio-engineering	LWD
Floodplain	14.3	Yes	S/G/C	FP/Eph	BF Bench/ FP	No	Flood-plain Mix	No	No

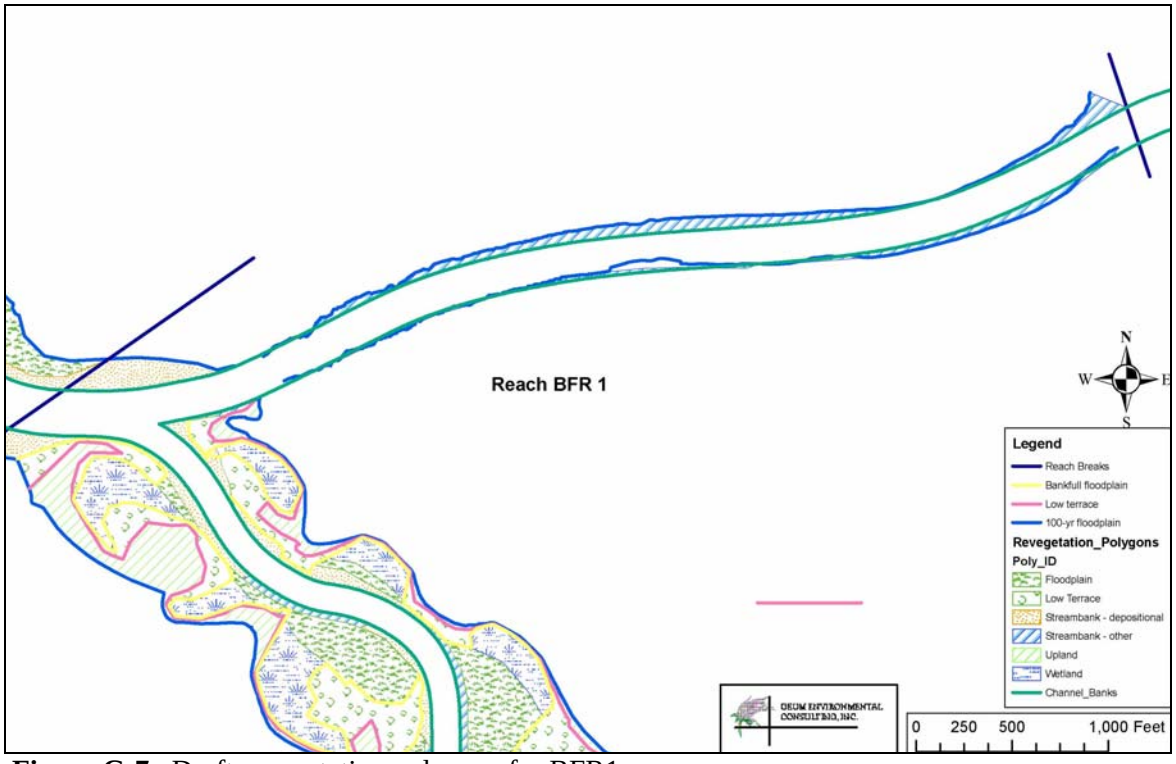


Figure G-7. Draft revegetation polygons for BFR1.